LAND-USE IN CENTRAL TUNISIA OVER THE LAST 2000 YEARS

Preliminary results

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ABSTRACT

The background, aims and methods of a palaeoecological project dealing with the climate-, landscape- and vegetation development and the effects of historical and present land use in areas bordering on the Sahara are presented. The project involves the studying of playa sediments by pollenanalytical, chronostratigraphical and geomorphological methods, to obtain information on the environmental changes connected to human impact and/or the variations in climatic conditions. Being bounded by the biggest desert area in the world, North Africa offers an excellent possibility to investigate the relationship between environmental variations, man and her culture. The research area is situating in the central part of Tunisia and belongs to the marginal zone of the northern Sahara where the desertformation and soil damage are the greatest and most serious problems today resulting mostly from intensive human activity.

General background

The northern Africa has been settled as early as the paleolithic and the archaeological finds give an evidence of settlements, cattle-rising, cultivation of wheat and barley around 8000 BP in the northern part of the eastern Sahara (Wendorf 1984, Aumassip 1984).

In the early Holocene the humid climatological conditions led to a notable decrease of the Sahara. During the limnological and biological optimum the paratropical hyperarid belt disappeared totally or almost totally. This has been proved for the eastern Sahara by eg Ritchie & Haynes (1988) and for the northern and north-western part of the Sahara by eg Gasse et al (1987). The humid conditions had a minimum duration of 2000 years (8500-6500 BP) and the favourable period came definitely to an end at about 4500 BP. The climatic deterioration resulted to the lowering of the water level. Saline deposits (cf chotts) and mud cracks stated to develop according as the evapotranspiration become higher than the precipitation.

The aridification trend is still going on, however, there have been two positive oscillations since 4500 BP, one around 3500 BP and the other around 2500 BP. (Acwu & Beug 1982, 1984, Rossignol-Strick & Duzer 1979). The Atlantic coast, the central (cf Mali), and the eastern parts of the Sahara have been relatively well investigated with respect to the man during the Holocene (eg Aumassip 1984, Ballouche 1986, Petit-Maire 1988, Dutour 1989). Vast areas in the central Sahara, which today are hyperarid, have been settled until 4000 BP. The migration of the semi-nomadic people from inner parts of Sahara northwards to the Mediterranean coast, and from east to west (from Nubia to Marocco), is known during the whole Holocene.

In Tunisia we have an evidence of settlements from the mousterian time (Gruet 1950, 1955a,b, Van Campo 1957, Van Campo & Coque 1960) and the early neolithic culture was of the same type which was common for the whole Mediterranean littoral. Artifacts left by hunters and fishermen are many and evidences point to the early domestication of cattle and the cultivation of crops in the area.

North Africas historical period starts in the 13th century BC when Phoenicians arrived in the coastal area of the modern Tunisia. They were trading people from Near East, Libya and Syria, where the agriculture has been established for several thousands of years ago. Phoenicians found Tunisian

shores suitable as trading posts and several towns were founded, eg Carthage. They control the traffic between the two basins of the Mediterranean and their flourishing economy was based on navigation, commerce and agriculture. The cultivation of cereals became more organized than before and the cultivated olive-tree (*Olea europaea* var. *sativa*) was introduced into the country (Brun 1983). In the 6th century BC Margo wrote a treatise on agriculture dealing with the cultivation of olives and grapes in the area.

After the Punic Wars (264-146 BC) the powerful Carthago was destroyed completely. Scipio destroyed not only the nation but he destructed also the soils. The soils were tilled and seeded with salt. Nevertheless, after the district became a Roman province, Tunisia became Rome's granary. It produced corn, olive, wine, fruits and wool.

Fields and orchards extended over the whole northern part of the country. Dams and roads were well developed. People moved from the coastal parts southwards and forest areas in the middle part of the modern Tunisia were taken to agriculture (Planhol 1968), (remains of the aqueducts and water reservoirs from the Roman Time are still found within the area investigated in this connection). Non-arable woodlands and mountain regions were under an intensive grazing.

Tunisia stayed as a Roman colony several centuries until 1500 BP when Vandals made a conquest. Their power lasted only ca 100 years and Tunisia became byzantine 1460 BP (year 530). During that time the agriculture became stagnant and the pastures expanded (Decret & Fantar 1981). In the 7th century the Arab Empire stretched over the land. Olivetree- and cerealea cultivation were again as important as during the Roman Time. Cattle-rising and sheep-farming were essential land-use forms even if the area stayed more or less continuous in war (Berbers, Egypts, Pirates, Turks etc). 1574 Tunisia became a Turkish province and remained so until 1881 when the French took over.

The Tunisian soils has been intensively cultivated and/or grazed since the times of Pheonicians. The pollen analysis from the coastal area (Gulf of Gabes) reflects a continuous change of the wild olive-tree dominated areas towards the *Artemisia* steppe since 2000-3000 BP. The development was at first relatively slowly but became faster during the last eight centuries (Brun 1983). Probably the great extension of well organized olivetree cultivation introduced by the French caused the rabid deterioration of the already hard overloaded arable soils in the beginning of our century. Within the investigated project area this change can be seen easily in the vegetation. The intensive sheep grazing ensures that the natural vegetation is even more sparse than under normal conditions. During the last few decades over 200 taxa have disappeared from the flora on the area. Those plants can still be found in the Natural Parc of Bou Hedma, in the southern part of the project area. The vegetation in the Parc is principally thorn savanna with shrubs and immediately outside the National parc it turns to a dry steppe.

Project aims

Against the very interesting archaeological and historical background there are several problems which need to be solved in the inland area (partly as a comparison to the investigations of Brun (1983) from the coastal area at almost the same latitude) and can be summarized in the following way:

1. The natural vegetation history and its relation to the climatic and human factors. It seems as the human activity has become successively more important factor with reference to the changes in the natural vegetation. Periods of the high respectively low water level have to be fixed both in time and space.

2. Changes of the tree limit. The Holocene history of *Pinus* and *Quercus* in the central part of Tunisia have to be described.

3. The history of the *Eucalyptus*-tree. The main opinion today is that the *Eucalyptus* has been planted in the central parts of Tunisia during the Roman Age. However, it is naturally growing within the climatically corresponding areas at the southern margin of the Sahara. It could be possible that the native *Eucalyptus* disappeared after the climatic optimum but was re-planted by the Romans.

4. The history of the wild *Olea* and *Olea europea* var. sativa (the latter was introduced by Phoenicians into Tunisia).

5. The history of *Juniperus* and other Cupressaceae. Today there is just one *Juniperus* growing in the area and that is in the National Parc of Bou Hedma. It is known that people burned up all juniper-bushes both during the Roman, Turkish,

Arabic and French colonization. Because of the historical documents it is very interesting to follow the development of this species.

6. Modern pollen sedimentation, pollen transport and long distance transport of pollen grains. Calibration of modern pollenproduction and climate.

Materials and methods

With reference to the agriculture and land-use the Sidi Bouzid area is one of the most exploited districts in central Tunisia. Chott Nejla, the place from which the preliminary investigated two meters sediment core comes, is situated just outside the town Sidi Bouzid (38°75'N,7°95'E) about 320 m asl (fig 1). The vegetation is poor on the very flat surface consisting of species of Compositae, Chenopodiaceae and Caryophyllaceae. In the surrounding areas outside the chott steppe vegetation is conspicuous, on the higher terrain some scattered *Acacia* and *Eucalyptus* trees are found. The climate is semi arid with the annual precipitation of 232 mm but it varies greatly. The annual dry season lasts 3-4 months and the mean annual temperature is +18°C.

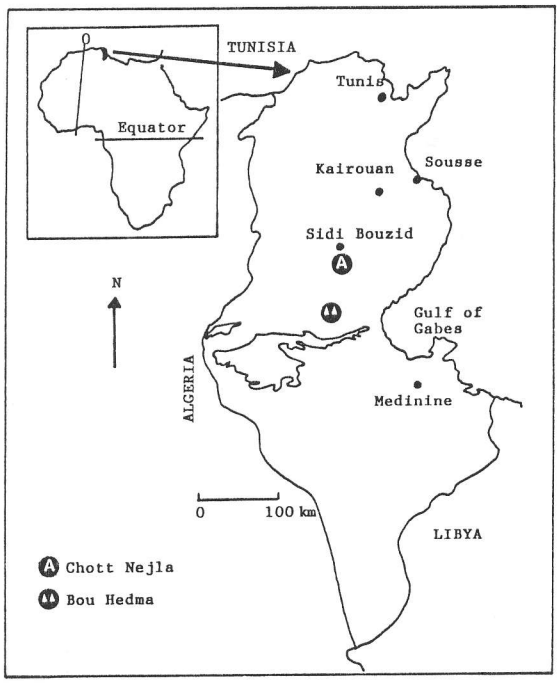

Fig 1. Location of the investigated area.

Because the investigated area is very poor in lakes the sediment core for the preliminary investigation comes from a chott. Chott is a sedimentary plane at the base level of a desert basin with interior drainage. Temporary lakes are often found in the central parts of these basins even if evapotranspiration is normally higher than precipitation. These lakes are salt-water lakes because water is continously removed by evapotranspiration while salt from the inflowing water remains in the basin. The surface of a chott is almost perpetually moist and particles, like pollen and wind transported mineral particles, easily become attached to the surface and are supposed to be incorporated in the sediment simultaneously with the salt accumulation. The chotts are mostly composed of stratified clay and silt beds deposited in the lakes. Due to the low amount of organic material in the samples for pollen analysis, low pollen frequencies were expected and the pollenmaterial was concentrated using a sedimentation-separation method (Påsse 1976). This method was consequently followed by the conventional acetolysis method (Faegri & Iversen 1975). At first hand the levels for datings have been investigated. The pollen concentration was low but acceptable in the lower part of the core. The uppermost meter was almost totally empty and the preservation of the found pollen grains was very bad. The quartz particle analyses has been performed by Franzén (Institute of Physical Geography, University of Göteborg) from samples taken at every 10 cm from the same sediment core as the other analysis. It has been proved that the form and brightness of quarztgranules depends to a high extend on climatic conditions. Round grains seems to have been transported under dry conditions (wind transport) while the more angular ones have been transported during more humid periods (fluvial transport) (Franzén, in press). The investigation of quartz particles provide information about deposition rate and water level changes when combined with dating methods. The sediment core will be carefully dated by means of ^{14}C (tandemacc.) and thermoluminescense for accurate interpretations of the pollen data and results of particle analysis. The modern pollendeposition will be investigated in the National Parc of Bou Hedma, about 100 km south from town Sidi Bouzid, where the five plant associations, which are supposed to be representative for the former vegetation of the whole Sidi Bouzid area, are still represented. The vegetation of the parc is very carefully mapped and changes in the taxa have been reported during years.

In the parc is also a meteorological station. Two pollen traps, originally designed by H. Tauber 1967, are at present placed in the area to collect both windborne pollen and pollen grains washed out of the atmosphere by rain. One of these is in the thorn savanna with shrubs and the other near by a natural spring in the foot of the mountain, where the vegetation is relatively rich due to the larger supply of

water. The collector consists of a simple cylindrical Perspex container (10 cm x 10 cm) which is closed at the top by an aerodynamically shaped collar (∅ 15 cm) with a circular orifice (∅ 5 cm). To prevent the trap in drying out 5 mm pure glycerine mixed with a few crystals of thymol is trapped on the bottom of the container. Thymol prevents the solution of bacterial and fungal growth and keep away the pollen collecting insects. The Tauber trap can take about 300 mm of precipitation before overflow. The sampling interval will be March - October, October - March. The collected pollen data will be correlated with the meteorological and phenological data in order to obtain the climatic parameters directly connected with the modern pollen rain. Canonical regression analysis will be applied in the finally treatment of the data. This type of pollen and quantitative climate reconstruction is recently done in East Africa (Roeland et al. 1988).

Preliminary results

At present only a few datings are available. On the basis of these the sediment core from Chott Nejla covers the period from ca 16000 BP. to the present. According to paleohydrological investigations from southern and western part of the Sahara the rate of sedimentation there has been considerably faster until about 5000 BP before the climatic deterioration (Petit-Maire 1989). In Sidi Bouzid area the rate of sedimentation appears to have been relatively even with the exception of the last 100 years, during which a layer of about 30 cm has accumulated. This may be a result of the intensive olive cultivation with methods which support the desert formation introduced by the French in the late 18th century. On the basis of the investigation of quartz particles three periods with high see level have been found in Chott Nejla: 1. 11000-10000 BP (just at the beginning of the climatic improvment), 2. 8000-6000 BP (the climatic optimum) and 3. during the Roman Time (a smaller one). These results fit well with those produced from the tropical West Africa (Kutzbach & Street-Perrot 1985, Lézine & Casanova 1989). However, the smaller positive oscillations during the last 4500 years are not so clearly found here, which probably has the connection to the relatively strong human activity in that part of northern Africa since 3000 BP.

The reconstruction of the vegetation on the base of the preliminary pollenanalytical results is very difficult. The upper parts of the playa sediment core (from about 4000 BP until present days) appears to be impossible to investigate and the pollen concentration of the lower part is so low that the interpretation is considered to be unreliable. After all, it is worth to mention that in the central part of Tunisia the vegetation has certainly been wooded pseudo-savanna during the climatic optimum. The number of found taxa is very high and pollen grains of *Olea*, *Quercus* and *Pinus* are found in a relatively high extend. Pollen grains from steppe elements are quite few. Some large Gramineae pollen are found (probably type Cerealea) around 4500-4000BP. For better results a new core have to be taken, probably from the National Parc of Bou Hedma, close by the spring mentioned before, where organic sediments can be found. On the other hand the knowledge of the pollen transport and pollen distribution in this part of Africa is still insufficient. We don't even know how strong is the influence of the seasonal and yearly heavy variations of rainfall, evapotranspiration and soil moisture on the pollen production and distribution.

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